CIRCUMSTANCES AND DETERMINATION OF INDIVIDUAL OUTCOMES IN BOLIVIA: FAMILY BACKGROUND AND EQUALITY OF OPPORTUNITIES (2003-2013)

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Circunstancias y determinantes individuales en Bolivia:
Caracteristicas de los hogares e Igualdad de Oportunidades (2003-2013)

Resumen
En el presente documento, se analizan los efectos de ciertas caracteristicas individuales, determinadas de manera exogena, en el ingreso individual y en los años educativos. Se recopila información para el caso de Bolivia y se aplica el marco teórico de la Igualdad de Oportunidades. El presente trabajo identifica las circunstancias relevantes que ejercen influencia, entre las que se encuentran, caracteristicas individuales (genero y etnia), y caracteristicas familiares sobre la composición del hogar y la educación de los jefes del hogar. Para tal fin, se emplean encuestas de hogares y se comparan diferentes periodos, para comprender los elementos relevantes en el análisis. Posterior a presentar un analisis descriptivo, y considerar diferentes modelos econometricos, se encuentra que las circunstancias identificadas representan un parte importante de la determinación del ingreso.
Palabras Clave: Igualdad de oporunidades , caracteristicas de los hogares, educación.
Clasificación JEL: D31, D63, J62.

Circumstances and determination of individual outcomes in Bolivia:
Family background and equality of opportunities

Abstract
Throughout this article, we analyze the effect of some circumstances, exogenously determined individual characteristics, over individual incomes and years of education. Gathering information for Bolivia and applying the theoretical scheme of Equality of Opportunity. This paper identifies relevant circumstances influencing outcomes such as the individual characteristics (gender, ethnicity) and family backgrounds (household characteristics and parental education). We studied and compared two household surveys for about ten years, in order to analyze whether these circumstantial factors are still relevant in determining the analyzed outcomes. After having evaluated different econometric models, strengthened by a descriptive analysis, we found that the identified circumstances are a vital part of income determination, and still being a significant part in education level determination in Bolivia. Despite these facts, we could also observe that within ten years the conditioning of income in those selected circumstances is less significant for the country, suggesting that there could be improvements in the equality of opportunities.
Keywords: Inequality of opportunity, family background, parental education.
JEL Classification: D31, D63, J62.

Circonstances et pondération d'essor en Bolivie : bagage familial et équité d'opportunités

Résumé
Cet article étudie les effets de certaines circonstances qui encadrent de manière exogène de caractéristiques individuelles parmi les gains individuels et années d'études. Il applique le schéma théorique d'Équité de Opportunités sur la Bolivie. Il identifie des circonstances qui influencent l'essor selon des caractéristiques individuelles (genre, ethnicité) et bagage familial (caractéristiques des ménages et éducation parentale). L'étude comparative de deux sondages sur les ménages sur dix ans analyse si les facteurs circonstanciels ont toujours un impact sur l'essor. L'évaluation de différentes méthodes économétriques, renforcées par l'analyse descriptive, démontrent que ces facteurs circonstanciels ont toujours un impact sur le gain de capital, surtout sur le niveau de l'éducation en Bolivie. Néanmoins, on observe que cet effet s'estompe au cours des dites dix années de sondage. Ceci montre une amélioration dans l'équité d'opportunités.
Mots-clés: Iniquité d'opportunités, bagage familial, éducation parentale.
Nomenclature JEL: D31, D63, J62.

Artículo de Investigación

CIRCUMSTANCES AND DETERMINATION OF INDIVIDUAL OUTCOMES IN BOLIVIA: FAMILY BACKGROUND AND EQUALITY OF OPPORTUNITIES

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INTRODUCTION

This paper analyzes the effect of family background and personal characteristics over the determination of the outcomes achieved by individuals with ages between 23 and 40 years old in Bolivia. In this sense, we analyze how specific circumstantial factors (i.e. individual and family characteristics, whose determination does not depend on the individual's decision and are exogenously determined; such as: gender, ethnicity, parental education, household size, etc.) play an important role over income determination and over achieves years of schooling. This study compares two temporary cuts by using information contained in two household surveys for Bolivia, in order to identify the effect of certain circumstances over evaluated outcomes, and then compares if these factors have the same predominance (or not) on outcomes over the time .

This research is based on the theoretical scheme of Equality of Opportunity, initially developed in the political philosophy literature and later adopted in the theoretical and empirical studies of normative economics. This conceptual framework suggest the existence of certain factors (whose determination does not depend on the individual) constraining the level of outcomes achieved by an individual. The Equality of Opportunity approach is a brand-new research field in Economics. Thus, few associated empirical studies are found relative to other academic fields in economic research. Although, its early development has not prevented that several institutions have been interested on the analysis of circumstantial factors, in both developed and developing countries.

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The related studies suggest that in developed countries, circumstances such as ethnicity or race, and geographic location of the household within a same country, are the main factors that determine a richer or more educated individual, and in contrast those factors make others poorer and less educated. As an example, in the United States and European countries, been black or living in distant areas far from the financial centers, automatically reduce individual's income. This evidence shows that not only the developing countries should be concerned with the field of Equality of Opportunities, nonetheless this evidence suggests that this characteristics are presented in many societies.

Moreover, studies on Equality of Opportunity for developing countries evidence that the prevailing circumstances in this group of countries are the levels of education attained by individual's parents, the employment status of the household head, and ethnicity. This emerging evidence clearly shows that while inequality of opportunity is present in both developed and emerging countries, main circumstances in developing countries rely on factors related with family background over the determination of individual outcomes. Studies for Latin America evidence that the mother educational level is also another important determining variable in the outcomes achieved during life.

For Bolivia, it has only been found a couple of studies related with Equality of Opportunity. We reference a government report based on this theoretical scheme that attempts to study the outcomes achieved by children and young people based on their family background, but this report does not analyze inferentially how

family background would affect future outcomes of those children and young people treated in the report. However and as mentioned above, the studies for the case of Bolivia emphasize that parental education is a relevant limitation of the results achieved in adult life of children.

Considering all this facts, this paper identifies the effect and magnitude of a set of circumstances over personal income and also over achieved years of schooling, considering people over 23 years of age for Bolivia. In the set of variables related with circumstances, we consider an important subset of variables related with the educational family background, generating categorical variables on educational attainment by individual's parents. We also contemplate another circumstance subset of variables related with individual characteristics such as gender and ethnicity. Finally, we consider variables of geographic location and household size, to likewise find how these factors determine individual outcomes.

For this research, we use the information contained in two household surveys conducted in Bolivia: the Continuous Household Survey (2003/2004) and the Household Survey (2013). The selection of these surveys from a set of surveys for Bolivia (available from 1999 to 2013) is strictly related with the number of people over 23 years old that have available information on their family background. Other surveys contain insufficient observations for this kind of information requirement and thus could generate biased results. Even though, household surveys in Bolivia available and used in this study are not attempted to analyze the family background of individuals, we base out approach in similar empirical studies performed in the region that

carried a similar methodology and sample selection.

After appraising different econometric models, we evidence the statistical significance of some circumstance variables over the determination of: i) personal income and ii) the years of schooling attained by individuals. Before analyzing the results, a technical description of the estimates is presented. Emphasizing the identification strategy and solution of potential problems of heteroskedasticity and multicollinearity. Alternatives estimates covariance matrix are also reported. The results show that the circumstances vectors selected for this study are statistically significant on the income determination and much more significant on the years of schooling determination. We find that the educational family background is an important determinant of individual out- comes in Bolivia. However, we also find that this effect is less statistically significant for 2013, suggesting that some improvements in equality of opportunities could have been experienced in the country.

This paper is divided as follows. The first section outlines the approach and state of art of the Equity of Opportunities scheme. It also presents some empirical approaches developed both in the region and the country. The second section describes the data used in the study and its justification. The third section specifies the identification strategy and the econometric models used in the study. Some econometric digressions are also presented. The fourth section presents a detailed description of the results of work to finally close with the conclusions of the document.

ON THE CONCEPT OF EQUALITY OF OPPORTUNITY

In contrast to the prevailing research on income inequality, there is a literature based on normative economics arguing that judgments about equity should only be applied over the access to opportunities rather than only over personal outcomes achieved (such as income, Dworkin, 1981; Cohen, 1989; Roemer, 1998; Roemer, 2009; Satz, 2010 and in some extent Sen, 1999). The conceptual framework of the Equality of Opportunity emphasizes the relationship between the opportunities[1] available to an individual and the initial conditions that are beyond to his control limiting her access to those opportunities. In this sense, this field claims that any outcome achieved by an individual could be explained by two basic factors: those factors that are under the control of the individual and those who are not.

According to Peragine, Palmisano, and Brunori (2014), the interest on Equality of Opportunity, regardless of their intrinsic normative justification, is now motivated by instrumental reasons. This implies that the degree of inequality of opportunities in an economy is negatively related to its potential for future growth and so for its level of development. There is also a widespread normative view that inequality of opportunity matters for the design of public policy, since only differences that limit the access of opportunities should be the object of compensation by the government.

It has also been suggested that inequality of opportunity might be a more relevant concept than income inequality, in order to understand the main reasons and not only the consequences of inequality. Checchi

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1 such us: education, health, employment, etc.

and Peragine (2010) suggest also that the lack of access to opportunities plays a key role in determining individual earnings in the occupation of the individual, in the existence of allocative inefficiency of resources, and lower growth potential. The existence of inequality traps in access to opportunities such us education, that systematically exclude certain groups of the population to participate in economic activity is extremely dangerous for economic growth.

Inequality is mainly a result (Deaton, 2013), and must be analyzed beginning with the identification of its main determinants. Outcomes inequality (e.g. income) may be associated with individual efforts in response to market incentives; but also inequality could be explained by a limited access to social services (health, education, etc.), geography and social exclusion, factors not determined by the individual, also called circumstances. The circumstances of an individual, such as parental education, geographic location, socioeconomic status, etc. are logically exogenous of her decision and are beyond the control of the individual, so she should not be held responsible for them. Inequality caused by differences in the circumstances, often reflects social exclusion weaknesses in systems of property and civil rights, and therefore according to Ali (2007) should be addressed through public policy interventions.

On the other hand, inequalities in income are also explained by differences in individual effort, which obviously is under the control of the individual and for which she should be held responsible. Inequalities caused by the individual's effort arise from differences in incentives. Therefore, inequality in income reflects the combination of these two differences:

i.e. differences in efforts or the set of actions that are under the control of the individual; and the differences in circumstances or economic, social and biological factors beyond the control of individuals (as identified by Roemer, 1998).

Inequality resulting from differences in efforts is acceptable and even desirable, because it would reflect an economy that provides incentives to work harder. However, inequality resulting from differences in circumstances, is not only ethically unacceptable but also becomes in a loss of productive potential and the misallocation of resources. In addition to the circumstantial disadvantages in access to education, health, these also make job opportunities distributed unevenly, which can create additional disadvantages, negatively affecting the amount of effort that individuals are willing to perform. The reduction of unequal opportunities caused by differences in circumstances should therefore be the goal of public policy.

The differentiation of inequality that arises from the efforts and those arising from the circumstances, leads to an important distinction between inequality of outcomes and inequality of opportunity (Lefranc, Pistolesi, & Trannoy, 2008). The inequalities in access to opportunities are mainly caused by differences in individual circumstances, while inequalities in outcomes such as earnings are a combination of differences in efforts and circumstances. If policy interventions fail to ensure equity in access to these opportunities, unequal outcomes only then reflect the difference in efforts therefore could be seen as a good inequality (Chaudhuri & Ravallion, 2007).

In these way, if all individuals exercise the same level of effort while policy

interventions can not fully compensate for the inconveniences resulting from differences in circumstances through equity opportunities, then inequality would cause a "bad inequality". While these two extreme cases are useful for analytical purposes, in reality, inequalities in outcomes consist of both good/desirable inequalities and bad/undesirable inequities. Thus Equality of Opportunity proposes a scheme for eliminating inequalities related to binding circumstances (Roemer, 2013).

1.1. Some empirical evidence

Despite the relevance of the Equality of Opportunity approach, there is not yet a considerable amount of empirical literature related with the topic and that is why quantitative approaches are incipient. Most of those published quantitative approaches are focused mainly on analyzing the effect of the circumstances over individual income, building some indexes of opportunity and analyzing their evolution[2].

Thus far, related literature provides different approaches to the measurement of inequality of opportunity. For example Bourguignon, Ferreira, and Menéndez (2003) estimate a linear model of advantages (earnings) as a function of circumstances and efforts, and use it to simulate counterfactual distributions where the effect of circumstances is suppressed. By comparing the actual earnings distribution with different counterfactuals and applying their methodology for the Brazilian case, the authors decompose overall earnings

inequality into: one component of five observed circumstance variables and a residual. This circumstance component is further decomposed into a direct effect and an (indirect) effect that operates through the influence of circumstances on the choice of efforts. This approach, seeks to estimate the contribution of the five specific observed circumstances contained in their dataset, such us: race, education of parents, region of birth, and labor category of the father. By imposing certain restrictions on coefficient signs and on their variance–covariance matrix, they estimate bounds on the possible biases arising from the omission of other unobserved circumstance variables.

In another quantitative approach relevant for Latin America, Ferreira and Gignoux (2011) construct a simple scalar measure of inequality of opportunity and apply this methodology to six Latin American countries. Their measure is shown to yield a lowerbound estimate of true inequality of opportunity. Absolute and relative versions of the index are defined, and alternative parametric and non-parametric methods are employed to generate robust estimates. In the application for Latin America countries, Ferreira and Gignoux (2011) find inequality of opportunity shares ranging from one quarter to one half of total consumption inequality. An opportunity-deprivation profile that identifies the worst-off types in each society is also formally defined, and described for the analyzed countries. By some OLS regressions, this approach also seeks to estimate the contribution of the five specific circumstances observed in analyzed countries: race, education of parents, region of birth, and labor category of the father.

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2 See Weymark (2003); Schütz, Ursprung, and Wöß-mann (2008); Paes de Barros, Vega, and Saavedra (2008); Paes de Barros (2009); Ferreira and Gignoux (2011), among others.

In Bolivia, there is only one study based on the circumstances and efforts approach by Roemer. Rocha (2007) highlights the role of inequality of opportunity, associated with parental education, ethnicity and gender of the individual, over labor income inequality. Using econometric estimates, the author shows that for 2003-2004, years of schooling as a proxy of effort and years of parental education as a proxy of circumstance, are the most significant variables over the determination of labor income. This study determined that households with better educated parents have children with higher incomes compared to parents with few years of education.

Rocha (2007), considers the education of parents as a determinant of income of the children in Bolivia, performs a simulation equalizing parental education and obtains a reduction of 6.29 percent in the Gini coefficient of 11.66 percent and the coefficient of Theil. The author also argues that given the results obtained, it is necessary to consider a very important aspect: the goal of a policy in Bolivia should seek equality focused primarily "on equal opportunities and not on income" (sic. Rocha, 2007 p.71).

UDAPE (2012) published a study called "Equal Opportunities for Children and Youth in Bolivia". This report develops a measure of equal opportunities for children and youth, from a rights perspective. Arguing that the promotion of equal opportunities must be defended from the political spectrum to achieve a fairer society, the report estimates the socalled Human Opportunity Index (HOI) Paes de Barros (2009), which represents a measure that incorporates both average coverage in access to opportunity and inequality in its distribution. The study

results, which considers information 1994, 1998, 2003 and 2008 show that so far the historical evolution of HOI in Bolivia was positive in health dimension (mainly access to vaccination). And also highlights the trend of HOI dimension in education is also positive (access and timely completion of primary and secondary education). However, access to opportunities in infrastructure, are not so favorable. While this study examines matters relating to equal opportunities, this analysis is limited to differences in gender, gender of household head, household structure, education of household head and income decile. Considering the small number of studies on the Equality of Opportunity for Bolivia, this document seeks to provide another approach to generate new research related.

DATA

In this section, the paper describes the details of chosen databases, also the justification for their use and possible limitations that could affect the econometric estimations. The temporary selection of 2004/2003 and 2013 surveys for the study is also justified. Subsequently, a statistical description of the variables is presented.

2.1. Surveys description

Taking the case of Bolivia, we use two household surveys systematized by the National Statistics Institute (INE hereinafter, for its acronym in spanish). The first one is the Continuous Household Survey of 2003/2004 (CHS 2003/2004, hereinafter), and the second, the Household Survey collected in 2013 (HS 2013, hereinafter). Table 1 presents the number of observations and the number of households belonging to each survey. This

Table 1: Household Surveys Description

Description	(1)	(2)
Original sample		
Title	Continuous Household Survey	Household Survey
Year	2003/2004	2013
Number of households	9553	9149
Number of observations	38500	35693
Average household size	5.37	4.77
Minimum household size	1	1
Maximum household size	18	16
Sample selection		
Observations with 25 to 40 years old	9382	9432
Observations with 25 to 40 years old with family background	2161	3118

Source: Continuous Household Survey 2003/2004,
2013 Household Survey 2013 (Instituto Nacional de Estad´ısticas - Bolivia).

information, broadly speaking shows that there is not a considerable difference in dimensions, nor in households surveyed, or even in average household size, between CHS 2003/2004 and the HS 2013. This feature determines that it is possible to compare the results of econometric estimates performed in this study. Both sur- veys contain a wide range of variables that characterize both the individual, family and housing characteristics.

From 1999-2002 Bolivia's National Institute of Statistics carried out a household survey as part of the Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI). For the years 2003-2004 the statistical organization created a survey that focused on collecting income and expenditure data over a longer period of time than in previous years. In addition to detailed information on income and expenditures of households, the survey also provided data on household

demographics, education, health, employment, and housing conditions.

From 2005 to 2013 (with a break in 2010) the form of specific household surveys returned, with the implementation of the Household Survey, which remain as theme of exploration, the living conditions of the Bolivian population through the implementation of multithematic questionnaire to research the general characteristics, health, education, employment, income, expenses, housing and independent farmer income. These surveys show an increase of sample size through the years, with the last survey of 2013 has the largest sample size.

For this study bases CHS 2003/2004 and the HS 2013 were chosen. This selection is based on three basic criteria. First, and as shown in Table 1, these bases have larger sample sizes of the whole series of household surveys in Bolivia, available from 1999 to 2013. As mentioned above, this feature is also a first criterion which

enables the comparison of results between selected bases. The second criteria for the selection of the samples, also seen in Table 1, is that these bases as well as being the largest in the series, also have a significant and similar number of observations for individuals between 23 and 40 years (population of study) with information about their family background. Third, there is a considerable temporal space between the selected surveys (equivalent to ten years), letting us to estimate possible changes in the determination of analyzed outcomes, according to the study variables.

Although the selection criteria of databases for this study in Bolivia are considerably solid, it is necessary to identify a possible weakness that is beyond the control of this research. Similar studies on inequality of opportunities conducted in countries of the region generally used databases on household surveys that were conducted with the explicit objective of collecting information on individual's family background. The existence of household surveys with specific questions about family background allowed the application of several studies on inequality of opportunities, especially in Brazil, Colombia, Ecuador, Guatemala, Panama and Peru (Ferreira & Gignoux, 2011).

As mentioned above, the series of household surveys available from 1999-2013 (regardless of their different names), are actually aimed for studying poverty, education, health, income of individuals, with out registering directly family background of adults (especially parents information). Therefore, the reduced samples for each year of study only consider people between 23 and 40 who still live with their parents (whether or not household heads). This could become a weakness of the study, however, the

reduced samples are large enough and their proportion to the original sample are similar to the proportions registered in studies conducted in countries of the region. It is also necessary to clarify that this way of selecting the study sample, is also performed by Rocha, 2007 to Bolivia for the CHS 2003/2004. However, we recognize that it would have been ideal to work with a survey whose explicit purpose were to analyze factors associated with family background of people in Bolivia.

2.2. Variable Description

As shown in Table 2, we generated different variables that approach circumstances factors over individual outcomes determination. Above we describe these variables classified in three main groups:

- **Personal characteristics:**
  Regarding to specific individual circumstances, we define two important variables: gender and ethnicity. Since gender inequality, and disadvantages faced by indigenous are relevant issues in Bolivia, we construct dummies according to the information contained in household surveys. Studies on Equality of Opportunity usually only identify these two personal variables as part of individual circumstances[3].

- **Family background:**
  In this group, we include those inherent characteristics related with individual's parents and household. These variables are generated by: i) the geographical location of the home, defining whether the individual's

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3 A complete description of these dummy variables is presented in Table 2.

home is located in a rich region or in a poor one[4]. ii) the employment status of the father, according to Ferreira and Gignoux (2011), we generate a dummy for parents with agricultural occupation, following the Classification of Economic Activities in Bolivia INE (2005). iii) a proxy for the size of the household, considering the sum of sons and daughters within a household; and iv) education level of father and mother, both in years of schooling and also as categorical variables according to the latest educational level attainment (also seen in Table 2).

- **Outcome variables:**
  For this study, we consider two individual outcome variables for people between 23 and 40 years old with family background information. i) the first outcome variable is the personal income, which by household survey CHS 2003/2004 and HS 2013 definition, reflects labor income (main and secondary occupation, if any) plus non labor income (remittances, rentals, etc.) for each individual. Before using data, we run an identification of outliers with the BACON algorithm (Billor, Hadi, & Velleman, 2000), then selected outliers are drop out. For the econometric identification, the income variable is transformed into logarithms to avoid dealing with problems of distribution. ii) The second outcome variable is years of schooling attained by those between 23 and 40 years old, with family background information. In this case, the variable of education reported in both household surveys (and measured in years) are used.

(IN)EQUALITY OF OPPORTUNITIES IN BOLIVIA

3.1. Circumstances that define outcomes in bolivia

This section identifies circumstances that have an effect on the results achieved by individuals with ages between 25 and 40 years old. Considering three subsets of circumstances variables (i.e. family background, personal characteristics and geographic characteristics) we analyze the conditional cumulative and relative distribution function for each circumstantial subset of variables.

3.1.1. Conditional outcomes to personal characteristics

As a first approximation of the effect of individual circumstances on individual outcomes, we analyze the two relevant personal characteristics, gender and ethnicity[5]. For testing this, let us describe personal income distributions conditional to gender and ethnicity dummies. As shown in Figure 1, the relative distribution of personal income of women have a slight bias to the left compared to the distribution of men. This difference is clearly more evident in 2013 than in 2003/2004. Therefore, in addition to the graphic analysis, we perform a mean comparison t-test for personal income conditional on gender. The results of this test, presented in Table 3, shows us that there is a significant difference between the personal income of men and women $Pr(|T|>|t|) = 0.0000$. These references allow us to include the gender variable as part of the possible variables of circumstances relevant for Bolivia.

Now considering the ethnicity condition, outcomes conditioned to this status show

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4 In this case we take the departments of La Paz, Cochabamba and Santa Cruz, as the richest regions of Bolivia

5 Clearly, these are preset since birth and are out of individual's control.

that this personal characteristic implies lower levels of personal income. The resulting Kernel densities for both samples (Figure 2) show us that the difference in income distribution by ethnic status is more pronounced in 2003/2004 than in 2013. This last feature could be explained by the socio-political processes lived in the country since 2006, reflected in a higher socio-economic inclusiveness to the indigenous nations in the country. If however, as seen in Table 3, the mean comparison test for 2013 shows that there is still a significant difference between income by ethnicity $Pr(|T|>|t|) = 0.0000$.

In analyzing the second outcome i.e. years of schooling, Figure 3 and Figure 4 show that ethnicity is also associated with lower levels of educational attainment in both periods and with significant differences regarding to non-ethnic. However, differences in education by gender show no major differences, and even by 2013 (Figure 3b), it is determined that women reach levels slightly higher education than men.

3.1.2. Conditional outcomes to family background

In this paper, we want to quantify and understand how family background affects the results achieved during the life of an individual, focusing on the importance of parental education over kids achievements. Before analyzing the effect of parental education, we consider three other related factors that influence achieved results of individuals: the employment status of the household head (father)[6], the geographical location of the household[7], and the household size as the

sum of sons and daughters at home (as a proxy to the trade-off between household size and investment in education of children[8]).

Table 3 presents the results of the test for average personal income conditional to farm worker father and household geographic location in a rich region. The results show that there is a significant difference between the income of people in the sample, with farm-worker father compared with those parents who do not work in the agricultural sector $Pr(|T|>|t|) = 0.0011$. Also, the test determines a statistically significant difference between individuals with household in rich regions than households in poor regions $Pr(|T|>|t|) = 0.0000$.

Regarding to the determination of the results conditional on parental education, the descriptive results show two important features. In the first instance, Figure 5 shows the cumulative distribution functions (CDF) for personal income, conditional upon the level of education of the father. As can be seen by comparing with the orignal CDF, CDF conditional on uneducated father has a bias to the left of the distribution. Instead, CDF conditional on father with tertiary education has a bias to the right of the income distribution. That is, those with less educated father clearly have lower incomes than people with parent with tertiary education. The CDF for parents with primary and secondary education are close to the original distribution and show a movement to the right as the educational level is higher. Similarly, Figure 7 shows the conditional CDFs at the level of education attained by the mother of the individual. The pattern is

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6 Ferreira and Gignoux (2011).

7 Chetty, Hendren, Kline, and Saez (2014).

8 Becker and Chiswick (1966).

similar to that registered regarding parent education, distribution takes a bias to the right with increasing education of the mother.

However, comparing the CDFs between 2003/2004 and 2013 and also the behavior of the kernel densities of Figure 6 and Figure 8, we show another important finding of this research. Both kernel densities conditional on father's education and kernel densities subject to the mother's education, show that by 2013 there is no longer much dispersal among distributions (see Figure 6b and Figure 8b), i.e. this suggests that for 2013 education of parents do not generate large differences in incomes as those dispersal distributions observed in 2003/2004 (the conditional distributions seem to concentrate). This finding will be tested in the econometric approach.

3.2. Econometric approach

This section follows the Bourguignon, Ferreira, and Menendez (2007) and Ferreira and Gignoux (2011) mathematical formalization of John Roemer's circumstances vs. efforts approach to inequality of opportunity. Subsequently, this paper provides an econometric identification strategy based on this conceptual framework.

Based on Roemer (1998) conceptual framework, we denote earnings by y, circumstance variables by the vector C, effort variables by the vector E, and other unobserved determinants by u. In this sense, we can define the earnings function as:

$$y_i = f(C_i, E_i, u_i) \qquad (1)$$

Following the literature review, circumstance variables are mainly exogenous by definition. However, effort variables could be also affected by circumstances, as well as by unobserved factors affecting efforts (we would denote this with z). This consideration lead us to re-define the earning function as:

$$y_i = f[C_i, E_i(C_i, z_i), u_i] \qquad (2)$$

In order to perform some empirical estimations, we could log-linearize Equation 2 in order to obtain an equations system like:

$$log(y_i) = C_i \cdot \gamma + E_i \cdot \delta + u_i \qquad (3)$$

$$E_i = C_i \cdot \beta + v_i \qquad (4)$$

where:

$$u_i \perp C_i \qquad \wedge \qquad v_i \perp C_i$$

where y_i will denote personal income, γ and δ are coefficient vectors and u_i is an *i. i. d.* ~ *N* (0,1) random variable, that accounts for unobserved circumstance and effort variables; sheer luck; and measurement error. If one wished to interpret current wages, y_i, as a proxy for permanent income or 'economic status', then u_i would also include transitory income shocks. β is a matrix of coefficients linking the circumstance variables to the effort variables. This matrix explicitly allows for the fact that some of these effort variables are clearly affected by circumstances. Formal schooling, for example, is determined at least in part by family background.

This effect of parental background on the educational outcomes of the next generation may occur because more educated parents provide more "home inputs" into an "education production function", such as books, vocabulary and

quality time spent on homework, but it may also reflect individual learning about the returns to effort, which maythemselves depend on the circumstances and indeed on the previous mobility history of the family. v_i is another white-noise disturbance term *i. i. d.* ~ *N* (0,1), orthogonal to the vector *C*, as indicated.

Econometric specifications

To apply the circumstances and efforts approach for Bolivia, we appraise different econometric models under two different procedures: i) first we want to analyze how vector C of circumstances affects individual outcomes separately. Moreover ii) we studied the determination results by cir- cumstances and efforts, as an earnings function defined above.

i) First approach - OLS with regression sub-vectors In this approach, we want to estimate how circumstance vector *C* affects the determination of individual outcomes, that for this study are: personal income and years of schooling. For both outcomes, we apply the following specification. Considering circumstance vector *C* and following Hansen (2015), let the regressors be partitioned as:

$$C = [C_p \quad C_f]$$

where *Cp* will denote circumstances associated with personal characteristics (i.e. gender and ethnicity), while *Cf* will denote circumstances associated with family background (i.e. father's labor status, household size and location, parental education). Then we can define the projection of the outcome variable y on *C* as:

$$y = C\beta + e \tag{5}$$

$$y = C_p\beta_p + C_f\beta_f + e \tag{6}$$

The Estimator ($\beta = \beta_p', \beta_f'$) is obtained by regression of **y** on $C = [C_p \ C_f]$ and can be written as:

$$y = C\hat{\beta} + \hat{e} = C_p\hat{\beta}_p + C_f\hat{\beta}_f + \hat{e} \tag{7}$$

We are interested in the algebraic expression for $\hat{\beta}_p$ and $\hat{\beta}_f$. In OLS regression model (as in Equation (5) is definided as:

$$\hat{\beta} = \hat{Q}_{CC}^{-1}\hat{Q}_{Cy} \tag{8}$$

In this case, de partition define $\hat{Q}_{CC}$ and $\hat{Q}_{Cy}$ as:

$$\hat{Q}_{CC} = \begin{bmatrix} \hat{Q}_{pp} & \hat{Q}_{pf} \\ \hat{Q}_{fp} & \hat{Q}_{ff} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{n}C_p'C_p & \dfrac{1}{n}C_p'C_f \\ \dfrac{1}{n}C_f'C_p & \dfrac{1}{n}C_f'C_f \end{bmatrix}$$

and similary:

$$\hat{Q}_{Cy} = \begin{bmatrix} \hat{Q}_{py} \\ \hat{Q}_{py} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{n} C_p' \boldsymbol{y} \\ \dfrac{1}{n} C_f' \boldsymbol{y} \end{bmatrix}$$

By this, we have: $\widehat{\boldsymbol{Q}}^{-1}$

$$\hat{Q}^{-1} = \begin{bmatrix} \hat{Q}_{pp} & \hat{Q}_{pf} \\ \hat{Q}_{fp} & \hat{Q}_{ff} \end{bmatrix}^{-1} \approx \begin{bmatrix} \hat{Q}^{pp} & \hat{Q}^{pf} \\ \hat{Q}^{fp} & \hat{Q}^{ff} \end{bmatrix} = \begin{bmatrix} \hat{Q}_{pp.f}^{-1} & -\hat{Q}_{pp.f}^{-1}\hat{Q}_{pf}\hat{Q}_{ff} \\ -\hat{Q}_{ff.p}^{-1}\hat{Q}_{fp}\hat{Q}_{pp} & \hat{Q}_{ff.p}^{-1} \end{bmatrix}$$

Where $\hat{Q}_{pp.f} = \hat{Q}_{pp} - \hat{Q}_{pf}\hat{Q}_{ff}^{-1}\hat{Q}_{fp}$ and $\qquad \hat{Q}_{pp.f} = \hat{Q}_{pp} - \hat{Q}_{pf}\hat{Q}_{ff}^{-1}\hat{Q}_{fp}$.

Thus

$$\hat{\beta} = \begin{pmatrix} \hat{\beta}_p \\ \hat{\beta}_f \end{pmatrix} = \begin{bmatrix} \hat{Q}_{pp.f}^{-1} & -\hat{Q}_{pp.f}^{-1}\hat{Q}_{pf}\hat{Q}_{ff} \\ -\hat{Q}_{ff.p}^{-1}\hat{Q}_{fp}\hat{Q}_{pp} & \hat{Q}_{ff.p}^{-1} \end{bmatrix} \begin{bmatrix} \hat{Q}_{py} \\ \hat{Q}_{fy} \end{bmatrix} = \begin{pmatrix} \hat{Q}_{pp.f}^{-1} & \hat{Q}_{py.f} \\ \hat{Q}_{ff.p}^{-1} & \hat{Q}_{fy.p} \end{pmatrix}$$

Now

$$\hat{Q}_{pp.f} = \hat{Q}_{pp} - \hat{Q}_{pf}\hat{Q}_{ff}^{-1}\hat{Q}_{fp} = \frac{1}{n}C_p'C_p - \frac{1}{n}C_p'C_f \left(\frac{1}{n}C_f'C_f\right)^{-1}\frac{1}{n}C_f'C_f = \frac{1}{n}C_p'M_f C_p$$

Where $M_f = I_n - C_f(\frac{1}{n}C_f'C_f)^{-1}C_f'$ is the orthogonal projection matrix for C_f. Similary $\hat{Q}_{pp.f} = \frac{1}{n}C_p'M_f C_p$ where the orthogonal projection matrix for C_p is defined as:

$$M_p = I_n - C_p(\frac{1}{n}C_p'C_p)^{-1}C_p'$$

$$\hat{Q}_{py.f} = \hat{Q}_{py} - \hat{Q}_{pf}\hat{Q}_{ff}^{-1}\hat{Q}_{fy} = \frac{1}{n}C_p'\boldsymbol{y} - \frac{1}{n}C_p'C_f \left(\frac{1}{n}C_f'C_f\right)^{-1}\frac{1}{n}C_f'\boldsymbol{y} = \frac{1}{n}C_p'M_f\boldsymbol{y}$$

And $\widehat{\boldsymbol{Q}}_{fy.p} = \frac{1}{n}C_f'M_p\boldsymbol{y}$.

Therefore:

$$\hat{\beta}_p = \left(C_p'M_f C_p\right)^{-1}(C_p'M_f\boldsymbol{y}) \tag{9}$$

$$\hat{\beta}_f = \left(C_f'M_p C_f\right)^{-1}(C_f'M_p\boldsymbol{y}) \tag{10}$$

Thus, we are going to estimate three OLS estimators vectors established in Equation 8, Equation 10 and Equation 9. For the econometric estimations, we consider the following variables belonging to each circumstance vector:

- {Gender, Ethnic status} $\in C_p$

- {Family size, household geographic location, mother education, father education} $\in C_f$

ii) Second approach - Two-Steps Least Squares

Considering the conceptual framework of circumstances and efforts, as a simple approach to Bolivia, we estimate a model of two-stage least squares (2SLS), as defined in equations Equation 3. In this second approach, circumstance vectors are the same as the first approach, and we add an effort proxy variable related with years of schooling reached by individuals[9].

RESULTS

In this section, we present the results and interpretation of the different econometric approaches performed in this research. First, we present the estimated models that explain the determination of the outcomes analyzed (income and education) based uniquely on circumstances vectors defined in the methodology section. Each econometric specification is estimated for both household surveys (CHS 2003/2004 and HS 2013), holding on independent variables for comparison purpose on both magnitude of the effects and significance of the estimated coefficients.

In Table 4, six OLS models are presented related with the determination of the

logarithm of personal income for persons with ages between 23 to 40 years old, considering the CHS 2003/2004. The model (1) estimates the effect of personal circumstances subvector (C_p) only, defining that belong to an ethnic minority affects negatively and significantly to personal income. In this first estimated model, the gender variable has no statistical significance, contrary to what we expected. Models (2) to (6) then gradually introduced variables on the family background sub-vector (C_f).

Comparing models (2) to (6), the last model shows the greatest significance and the largest coefficient of determination (R^2), but also lower coefficients of Schwarz and Akaike, defining that model (6) is the best specification among those models fitting in our conceptual scheme. The model chosen, shows that gender dummy variable has a negative effect on personal income, but does not show statistical significance. According to this model, belong to an ethnic minority reduce personal income by 5 percent and the effect is statistically significant. The fact that the household of individual is located in a wealthy region significantly increases income by 14 percent. Having a farm-worker father reduces significantly income by 35 percent, and for each additional household member (a larger number of children) income decreased by 12 percent.

Furthermore, model (6) also determines interesting effects related with the introduction of dummy variables about education of father and mother. As expected, having a parent with higher education increases income significantly. For the case of the father, if individual's father reached primary education then son or daughter income increases by

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9 Bourguignon et al. (2007).

17 percent, whereas if a father reached secondary education his son or daughter income increases by 32 percent, and if a father instead reached tertiary education, his descendant's income increases by 62 percent. In the case of the mother, the effect of education over income determination for their children is even higher, reflecting that if the mother has no education, descendant income is reduced by 20 percent, whereas if the mother reaches the tertiary education income increases by 63 percent.

Estimates of the logarithm of personal income described show that all the variables identified as relevant circumstances using the CHS 2003/2004, except the gender variable, are highly significant and show the expected effects. The selected and described model (6) does not present problems of multicollinearity and heteroscedasticity problems when White test is applied.

Table 5 shows the same specifications as the previous table while alternatively using the HS 2013. The same procedure was performed, i.e. vectors were introduced subsequently to get the best-fitting model. Again, the specification (6) in Table 5 shows the highest determination co-efficient and lower coefficients of Schwartz and Akaike. Compared with the relevant model for the 2003/2004 survey, the model for 2013 shows the same direction of effects but less statistical significance in selected variables. Thus, the gender condition reduces income by 19 percent significantly; ethnicity reduced 2013 revenue by 30 percent, living in a rich region increases income by 15 percent, having a farmworker father reduces personal income by 21 percent and for each additional dependent household member the individual's income is reduced by 4.2 percent.

With regard to the effect of parental education and comparing the results for 2003/2004, the estimated model (6) (Table 5) for 2013 shows that a better educated father and mother generate a positive effect on income, i.e. the direction of effects was expected and it is consistent with the results for 2013. However, the fact that circumstance variables associated with parental education are no longer highly statistically significant is associated with the noted change in relative distribution frequency of kernel mentioned in a previous section. The only statistically significant variable for parent education is the dummy of tertiary education. In that case, having a parent with tertiary education increases income by 49 percent, while having a mother with tertiary education increases income by 22 percent. Apparently, in 2013 the tertiary education of parents is the only relevant difference between circumstances associated with the family background.

As defined in Hansen (2015), after to choose the specification (6) to both surveys, we proceeded to make the following specifications: i) Homoskedastic formula, ii) Scaled White formula, iii) Andrews formula, and iv) Horn-Horn-Duncan formula, to identify possible differences in the variance-covariance matrix and identify potential problems of heteroskedasticity. After performing those tests, we found no difference between these formulas and the White test does not identify problems heteroskedasticity.

Moreover, analyzing the determinants of personal income associated with the circumstances, now we propose OLS econometric models for determining the second outcome variable of interest in the study: years of schooling reached by individuals. Table 6 presents the

specifications made for CHS 2003/2004. As in previous models, gradually we introduce circumstance variables and choose the model with the highest coefficient of determination adjusted, lower coefficients of Schwartz and Akaike and greater amount of statistically significant variables. In Table 6, we also choose the specification number (6) that has the best values based on the mentioned criteria. In this model we can determine that the education of father and mother significantly determine the years of schooling of their descendants. Thus, having a father with only primary school education increases son or daughter's education in two years, while a father with tertiary schooling doubles this effect, i.e. increases education of descendant in four years. In the case of the mother, a mother with no education significantly reduces the schooling of her descendant in three years, while a mother with tertiary education increases her descendants education in one year.

In model (6) (Table 6), for the determination of the years of schooling considering the CHS 2003/2004, the personal characteristics variables report low significance especially for the gender variable. In the case of ethnic origin, the fact of belonging to an ethnic minority education reduces individual in 0.47 years. Furthermore, other circumstances variables associated with family background different from the education of parents described above are highly significant and show the expected signs. In that case, living in a rich region increases individual's schooling by 0.21 years; having a farmer father reduces education in 3 years, and for each additional household member the education of the individual is reduced by 0.16 years.

In spite of the models for determining the estimated income for 2003/2004 and 2013 we recorded a less significance in the independent variables of circumstance, the opposite happens in the estimates for the determination of the years of schooling of individuals. Table 7 shows that the selected variables circumstances are even more significant for 2013. Thus, being a woman reduces years of schooling by 0.37 years belong to an ethnic minority reduces years of schooling in one year, living in a rich region reduces years of schooling by 0.02 years. The latter is clearly associated with a reduction in the return to education encountered in Bolivia since 2006. People with a farmer father in 2013 reduce their education by 2.5 years, and for each additional household member individual's education is reduced 0.18 years.

The education of father and mother still shows high significance in the results for years of schooling estimated for 2013 also in the model (6) of Table 7. We can see that having a father with primary education increases descendant's schooling by 1.5 years, while a father with tertiary education increases descendant's schooling by 3.3 years. Regarding to the education of the mother, an uneducated mother's reduces her descendant's schooling in three years, while a mother with tertiary education increased years of schooling by 1.4 years. The model (6) estimated for both surveys show that the circumstances associated with family background remain relevant in the determination of education attained by individuals for 2013.

Finally and again following Hansen (2015), after to choose the specification (6) for both surveys, we proceeded to make the following specifications: i) Homoskedastic

formula, ii) Scaled White formula, iii) Andrews formula, and iv) Horn-Horn-Duncan formula, to identify possible differences in the variance-covariance matrix and identify potential problems of heteroskedastic- ity. Made this exercise, we found no difference between these formulas and the White test does not identify problems heteroskedasticity. Therefore, robustness results is demonstrated.

As a second econometric approach, we estimate a two-stages least square regression model for both surveys presented in Table 8 and Table 9. We will not make much emphasis on these estimates, since we recognize that years of education are a very weak proxy of effort. However, as a first evidence these estimates in two stages confirm the importance of circumstances vectors identified on the determination of income, and also show the effect on reducing the significance of parents education on the income of their descendants from 2003/2004 to 2013.

In this way, Table 8 shows that a father with a higher level of education increased income while the effect of mother education over descendant's outcomes show a more prominent effect. As commonly expected, living in a richer region increases both outcomes. Finally, in both 2SLS models gender variable is statistically significant and is associated with less income in a regression model controlled by other circumstantial factors.

CONCLUSIONS

This study has adopted the conceptual scheme of Equality of Opportunity, in order to explain and quantify how certain individual characteristics whose determination does not depend on the individual's decision could affect and determine their achieved outcomes (income and education level). After a theoretical and empirical review of the conceptual approach related with efforts and circumstances, the empirical literature described in the document showed how important it is to identify the variables of circumstances that determine individual incomes, as an encouragement for the proposals derived from this conceptual scheme.

Using two household surveys, we have determined that in the case of Bolivia, regardless of the gender and ethnicity variables, family background and educational level of parents plays a fundamental role in the determination of income and even more in the determination the years of schooling attained by people of 23-40 years old. As expected, having a father or a mother with a higher level of education significantly increases the income of their descendants. This effect is much clearer and consistent when we analyze its effect over the level of education achieved by individuals.

However, we found a relevant and interesting result as an encouragement future research in Equality of Opportunity. We evidence that those important circumstantial factors related with family background were highly significant for 2003-2004, but then were no longer highly significant for 2013 in all appraised models. This would suggest that in Bolivia, education of parents might no longer have a great weight on income of individuals. Thus, one could argue that Bolivia achieved some degree of improvement in terms of equality of opportunity over individual income as an outcome. However, this effect is not recorded when comparing the degree of significance of education of parents over

education achieved by descendants, being the most important determining that income, since education is a factor poverty reduction in the long term and contributes to economic growth.

It remains the analysis of the effect of efforts on the determination of outcomes, that should be the subject of future research to find better proxies for individual effort. In addition, we suggest further studies to corroborate the results found in this paper.

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TABLE 2: Generated variables description

Dummy variables		Number of observations		Description
Variable Name	Values	2003/2004	2013	
Women	= 1 if women 1035 1316	1035	1316	Gender variable.
	= 0 if men 1126 1489	1126	1489	
Ethnic	= 1 if ethnic language	237	188	Ethnicity variable, according to individual's native language.
	= 0 if non ethnic language	1924	2617	
Richer region	= 1 if lives in La Paz, Santa Cruz or Cochabamba	1225	2016	Geographic variable for individuals living in the richest regions of Bolivia.
	= 0 if lives in other regions	936	789	
Father an agricultural worker	= 1 if individual's father works in agriculture	214	226	Variable on the employment status of the father according to the national labor coding.
	= 0 if individual's father do not works in agriculture	1974	2579	
Father with no education	= 1 if father has no education	68	58	Father's education variable corresponding to the last level of education attained.
	= 0 otherwise	1339	1918	
Father primary education	= 1 if father has primary education	746	771	
	= 0 otherwise	661	1205	
Father secondary education	= 1 if father has secondary education	280	517	
	= 0 otherwise	814	1459	
Father tertiary education	= 1 if father has tertiary education	313	630	
	= 0 otherwise	1094	1346	
Mother with no education	= 1 if mother has no education	418	269	Mother's education variable corresponding to the last level of education attained.
	= 0 otherwise	1539	2264	
Mother primary education	= 1 if mother has primary education	905	1090	
	= 0 otherwise	1052	1443	
Mother secondary education	= 1 if mother has secondary education	327	612	
	= 0 otherwise	1630	1921	
Mother tertiary education	= 1 if mother has tertiary education	307	562	
	= 0 otherwise	1650	1971	

Source: Own.

TABLE 3: Mean-comparison tests by circumstantial variables

Mean income by gender

Group	Observations	Mean	Std. Error	Std. Deviat.	[95% Conf.	Interval]
Men	1167	2645.977	65.43947	2235.503	2517.584	2774.369
Women	956	2236.097	61.38637	1898.021	2115.629	2356.565
Combined	2123	2461.405	45.57122	2099.741	2372.036	2550.774
Difference		409.8796	91.18424		231.0598	588.6995
P r(|T| > |t|) = 0.0000						

Mean income by ethnic status

Group	Observations	Mean	Std. Error	Std. Deviat.	[95% Conf.	Interval]
No ethnic member	1988	2513.89	47.54645	2119.953	2420.644	2607.137
Ethnic member	135	1688.513	137.0157	1591.978	1417.52	1959.506
Combined	2123	2461.405	45.57122	2099.741	2372.036	2550.774
Difference		825.3772	185.9344		460.7443	1190.01
P r(|T| > |t|) == 0.0000						

Mean income by geographial location

Group	Observations	Mean	Std. Error	Std. Deviat.	[95% Conf.	Interval]
Lives in a poor region	570	2300.388	66.0929	1577.946	2170.572	2430.204
Lives in a rich region	1553	2520.504	57.31874	2258.824	2408.073	2632.934
Combined	2123	2461.405	45.57122	2099.741	2372.036	2550.774
Difference		-220.1157	102.7426		-421.6024	-18.62894
P r(|T| > |t|) = 0.0000						

Mean income by father laboral status

Group	Observations	Mean	Std. Error	Std. Deviat.	[95% Conf.	Interval]
Father no agric. worker	1988	2491.546	47.64395	2124.3	2398.109	2584.983
Father agric. worker	135	2017.554	141.2001	1640.597	1738.285	2296.823
Combined	2123	2461.405	45.57122	2099.741	2372.036	2550.774
Difference		473.9918	186.5124		108.2255	839.7582
P r(|T| > |t|) = 0.0111						

Source: Author's calculation based on: Continuous Household Survey 2003/2004,
Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia).

TABLE 4: OLS estimated model for personal income (2003/2004)

	(1) lyper	(2) lyper	(3) lyper	(4) lyper	(5) lyper	(6) lyper
Individual characteristics						
Women	0.010 (0.037)	0.010 (0.037)	-0.030 (0.034)	-0.038 (0.040)	-0.038 (0.040)	-0.046 (0.041)
Member of an ethnic minority	-0.741*** (0.059)	-0.741*** (0.059)	-0.697*** (0.056)	-0.288*** (0.072)	-0.288*** (0.072)	-0.301*** (0.073)
Household characteristics						
Richer region		0.212*** (0.037)	0.211*** (0.035)	0.145*** (0.041)	0.145*** (0.041)	0.141*** (0.041)
Father an agricultural worker			-0.497*** (0.059)	-0.339*** (0.061)	-0.339*** (0.061)	-0.355*** (0.062)
Household size			-0.155*** (0.010)	-0.114*** (0.011)	-0.114*** (0.011)	-0.118*** (0.011)
Parental Education						
Father with no education				-0.425*** (0.127)	-0.215 (0.119)	
Father primary education				-0.246*** (0.074)	-0.036 (0.059)	0.168* (0.107)
Father secondary education				-0.210** (0.070)		0.316** (0.119)
Father tertiary education					0.210** (0.070)	0.613*** (0.124)
Mother with no education				-1.004*** (0.096)	-0.527*** (0.084)	-0.194** (0.061)
Mother primary education				-0.852*** (0.081)	-0.375*** (0.066)	
Mother secondary education				-0.477*** (0.076)		
Mother tertiary education					0.477*** (0.076)	0.634*** (0.072)
Constant	6.302*** (0.026)	6.182*** (0.034)	6.705*** (0.044)	7.484*** (0.070)	6.797*** (0.077)	6.275*** (0.120)
Observations	2161	2161	2161	1215	1215	1215
R2	0.068	0.082	0.200	0.399	0.399	0.383
R2 adjusted	0.067	0.080	0.198	0.393	0.393	0.378
Degrees of freedom	2158	2157	2155	1203	1203	1204
BIC	5499	5474	5190	2632	2632	2657
AIC	5482	5451	5156	2571	2571	2601

* p < 0.05 - ** p < 0.01 - *** p < 0.001

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000)

TABLE 5: OLS estimated model for personal income (2013)

	(1) lyper	(2) lyper	(3) lyper	(4) lyper	(5) lyper	(6) lyper
Individual characteristics						
Women	-0.225*** (0.043)	-0.228*** (0.042)	-0.237*** (0.042)	-0.184*** (0.056)	-0.184*** (0.056)	-0.184*** (0.056)
Member of an ethnic minority	-0.579*** (0.088)	-0.599*** (0.088)	-0.560*** (0.088)	-0.302* (0.125)	-0.302* (0.125)	-0.302* (0.125)
Household characteristics						
Richer region		0.185*** (0.048)	0.187*** (0.048)	0.155* (0.062)	0.155* (0.062)	0.155* (0.062)
Father an agricultural worker			-0.283*** (0.085)	-0.215* (0.097)	-0.215* (0.097)	-0.215* (0.097)
Household size			-0.041** (0.014)	-0.042* (0.018)	-0.042* (0.018)	-0.042* (0.018)
Parental Education						
Father with no education				-0.484* (0.203)	-0.302 (0.194)	
Father primary education				-0.082 (0.097)	0.100 (0.079)	0.402* (0.183)
Father secondary education				-0.182* (0.086)		0.302 (0.191)
Father tertiary education					0.182* (0.086)	0.484* (0.198)
Mother with no education				-0.217 (0.138)	-0.001 (0.120)	-0.002 (0.101)
Mother primary education				-0.216* (0.103)	0.000 (0.079)	
Mother secondary education				-0.216* (0.091)		
Mother tertiary education					0.216* (0.091)	0.216* (0.088)
Constant	7.618***	7.485***	7.617***	7.852***	7.454***	7.152***
Observations	1864	1864	1864	1078	1078	1078
R2	0.036	0.044	0.054	0.070	0.070	0.070
R2 adjusted	0.035	0.042	0.052	0.060	0.060	0.061
Degrees of freedom	1861	1860	1858	1066	1066	1067
BIC	4971	4964	4958	2910	2910	2903
AIC	4955	4942	4925	2850	2850	2848

* p < 0.05 - ** p < 0.01 - *** p < 0.001

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000)

TABLE 6: OLS estimated model for the years of schooling (2003/2004)

	(1) edu	(2) edu	(3) edu	(4) edu	(5) edu	(6) edu
Individual characteristics						
Women	0.308 (0.180)	0.309 (0.180)	0.182 (0.174)	0.111 (0.189)	0.111 (0.189)	0.111 (0.189)
Member of an ethnic minority	-4.222*** (0.288)	-4.223*** (0.288)	-3.477*** (0.284)	-0.471 (0.337)	-0.471 (0.337)	-0.471* (0.338)
Household characteristics						
Richer region		0.420* (0.181)	0.397* (0.175)	0.213 (0.192)	0.213 (0.192)	0.212* (0.193)
Father an agricultural worker			-3.844*** (0.297)	-3.053*** (0.289)	-3.053*** (0.289)	-3.053*** (0.289)
Household size			-0.131** (0.050)	-0.156** (0.053)	-0.156** (0.053)	-0.156** (0.053)
Parental Education						
Father with no education				-4.464*** (0.597)	-3.790*** (0.561)	
Father primary education				-2.092*** (0.347)	-1.418*** (0.276)	2.372*** (0.497)
Father secondary education				-0.674* (0.329)		3.790*** (0.556)
Father tertiary education					0.674* (0.329)	4.464*** (0.578)
Mother with no education				-3.218*** (0.452)	-2.770*** (0.396)	-2.770*** (0.284)
Mother primary education				-1.340*** (0.381)	-0.893** (0.312)	
Mother secondary education				-0.447 (0.360)		
Mother tertiary education					0.447 (0.360)	0.447* (0.336)
Constant	12.447*** (0.128)	12.209*** (0.164)	12.969*** (0.222)	15.991*** (0.329)	14.870*** (0.363)	11.079*** (0.561)
Observations	2161	2161	2161	1215	1215	1215
R2	0.091	0.094	0.162	0.396	0.396	0.392
R2 adjusted	0.090	0.092	0.160	0.390	0.390	0.387
Degrees of freedom	2158	2157	2155	1203	1203	1204
BIC	12339	12341	12188	6397	6397	6398
AIC	12322	12318	12153	6336	6336	6342

$* p < 0.05$ - ** $p < 0.01$ - *** $p < 0.001$

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000)

TABLE 7: OLS estimated model for the years of schooling (2013)

	(1) edu	(2) edu	(3) edu	(4) edu	(5) edu	(6) edu
Individual characteristics						
Women	0.347* (0.153)	0.349* (0.152)	0.266 (0.148)	0.379* (0.164)	0.379* (0.164)	0.370* (0.165)
Member of an ethnic minority	-4.108*** 0.298)	-4.126*** (0.298)	-3.244*** (0.297)	-0.922** (0.355)	-0.922** (0.355)	-0.957** (0.356)
Household characteristics						
Richer region		0.626*** (0.169)	0.457** (0.165)	-0.022 (0.184)	-0.022 (0.184)	-0.019* (0.185)
Father an agricultural worker			-3.677*** (0.284)	-2.439*** (0.285)	-2.439*** (0.285)	-2.479*** (0.285)
Household size			-0.219*** (0.049)	-0.171** (0.055)	-0.171** (0.055)	-0.185*** (0.055)
Parental Education						
Father with no education				-2.857*** (0.580)	-1.954*** (0.555)	
Father primary education				-1.369*** (0.284)	-0.466* (0.236)	1.507** (0.521)
Father secondary education				-0.903*** (0.250)		2.306*** (0.549)
Father tertiary education					0.903*** (0.250)	3.327*** (0.568)
Mother with no education				-4.714*** (0.405)	-3.611*** (0.361)	-2.883*** (0.303)
Mother primary education				-1.971*** (0.297)	-0.868*** (0.236)	
Mother secondary education				-1.102*** (0.266)		
Mother tertiary education					1.102*** (0.266)	1.401*** (0.254)
Constant	14.265*** (0.107)	13.816*** (0.162)	14.792*** (0.204)	17.522*** (0.268)	15.516*** (0.300)	12.852*** (0.564)
Observations	3113	3113	3113	1820	1820	1820
R2	0.059	0.063	0.118	0.316	0.316	0.311
R2 adjusted	0.059	0.062	0.116	0.312	0.312	0.307
Degrees of freedom	3110	3109	3107	1808	1808	1809
BIC	17872	17866	17696	9786	9786	9792
AIC	17854	17842	17660	9720	9720	9732

* p < 0.05 - ** p < 0.01 - *** p < 0.001

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000)

TABLE 8: Two-stages Least Squares estimation for logarithmic income (2003/2004)
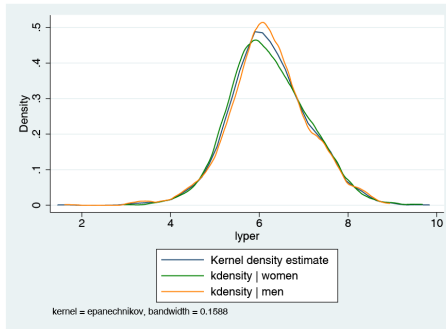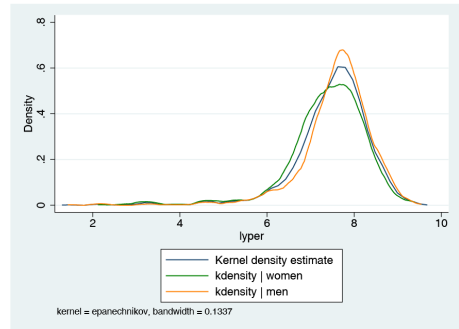
Instrumental variables (2SLS) regression						
		Observations		=		1215
		Wald chi2(12)		=		738.63
		Prob >chi2		=		0.0000
		R-squared		=		0.3308
		Root MSE		=		0.72821

Logarithmic personal income	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Education	0.174	0.025	6.92	0.000	0.124	0.223
Women	-0.081	0.043	-1.88	0.060	-0.165	0.003
Ethnicity	-0.234	0.077	-3.05	0.002	-0.384	-0.084
Rich region	0.103	0.043	2.38	0.017	0.018	0.188
Household size	-0.060	0.014	-4.24	0.000	-0.088	-0.032
Father with primary education	0.096	0.056	1.7	0.089	-0.015	0.206
Father with tertiary education	0.169	0.073	2.31	0.021	0.026	0.313
Mother withouth education	-0.253	0.100	-2.53	0.011	-0.449	-0.057
Mother primary education	-0.281	0.072	-3.92	0.000	-0.422	-0.141
Mother tertiary education	0.430	0.080	5.35	0.000	0.273	0.588
Experience	0.073	0.014	5.14	0.000	0.045	0.100
Experience 2	-0.063	0.026	-2.43	0.015	-0.114	-0.012
Constant	3.712	0.455	8.16	0.000	2.820	4.603
Instrumented:	Education					

Source: Author's calculation based on: Continuous Household Survey 2003/2004 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the Blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000).
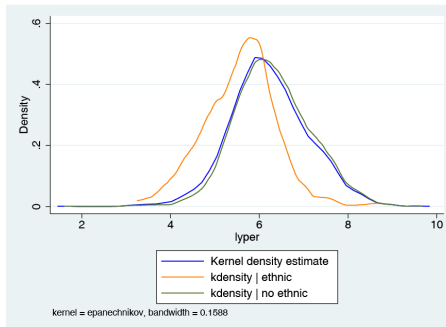
TABLE 9: Two-stages Least Squares estimation for logarithmic income (2013)

Instrumental variables (2SLS) regression						
		Observations		=		1215
		Wald chi2(12)		=		738.63
		Prob >chi2		=		0
		R-squared		=		0.3308
		Root MSE		=		0.72821

Logarithmic personal income	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Education	0.142	0.045	3.13	0.002	0.053	0.231
Women	-0.262	0.062	-4.21	0.000	-0.383	-0.140
Ethnicity	-0.304	0.124	-2.45	0.014	-0.547	-0.061
Rich region	0.209	0.064	3.27	0.001	0.084	0.335
Household size	0.001	0.023	0.02	0.980	-0.044	0.045
Father with primary education	0.136	0.074	1.83	0.067	-0.010	0.282
Father with tertiary education	-0.005	0.106	-0.05	0.962	-0.214	0.203
Mother withouth education	0.160	0.140	1.14	0.253	-0.114	0.434
Mother primary education	0.021	0.080	0.26	0.793	-0.137	0.179
Mother tertiary education	0.112	0.099	1.13	0.258	-0.082	0.305
Experience	0.055	0.018	3.04	0.002	0.020	0.091
Experience 2	-0.022	0.065	-0.34	0.735	-0.150	0.106
Constant	4.817	0.828	5.82	0.000	3.194	6.439
Instrumented:	Education					

Source: Author's calculation based on Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the Blocked adaptive computationally efficient outlier Notminators - BACON algorithm (Billor et al., 2000).
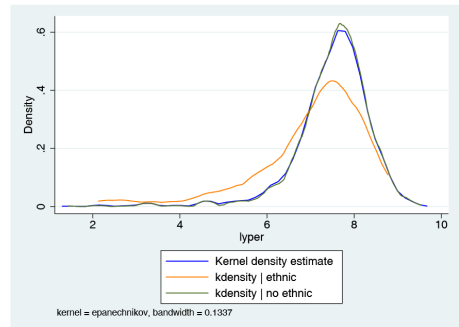
(A) 2003/2004

(B) 2013

FIGURE 1: Kernel density of logaritmic income conditional to gender
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
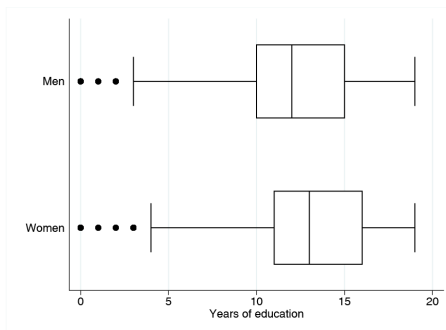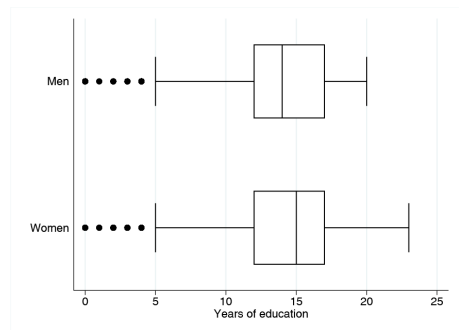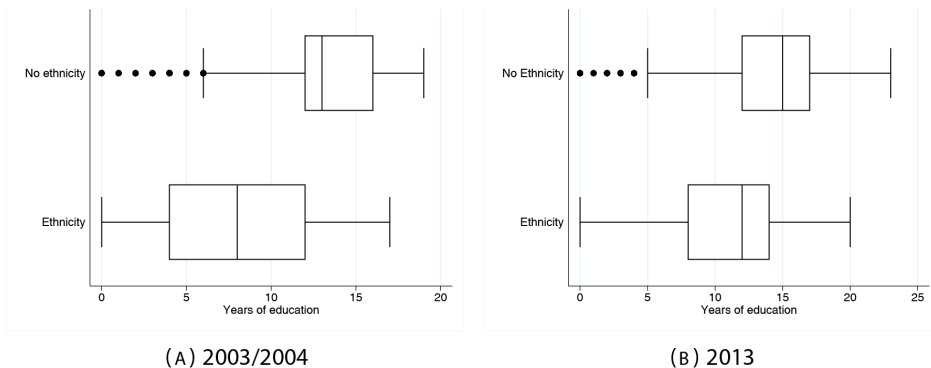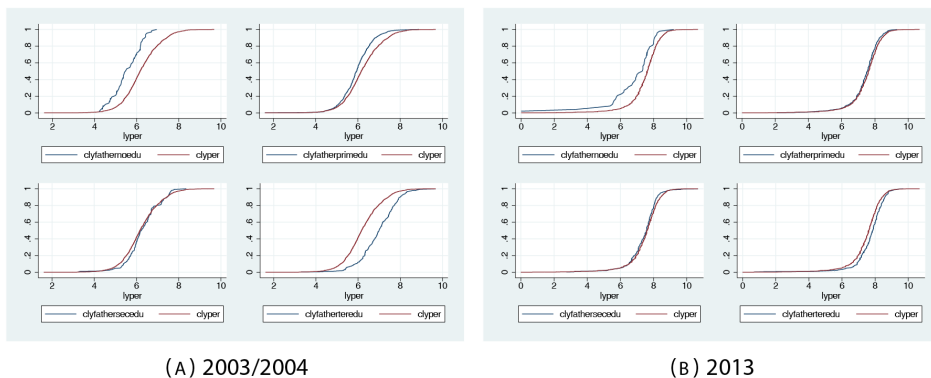

(A) 2003/2004

(B) 2013

FIGURE 2: Kernel density of logaritmic income conditional to gender
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
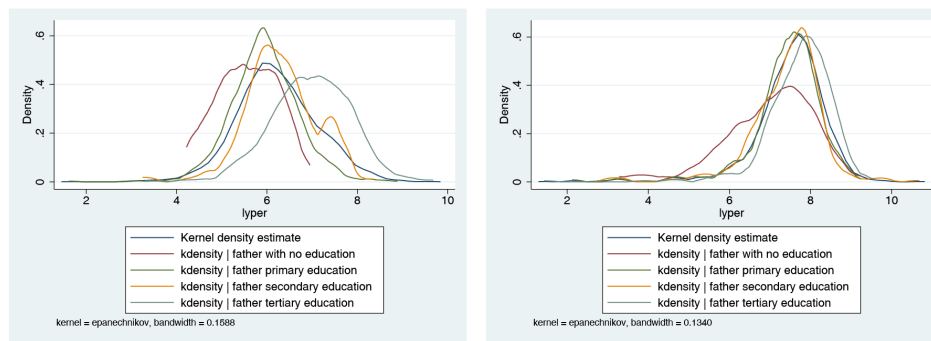

(A) 2003/2004

(B) 2013

FIGURE 3: Years of education conditional to gender
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013 (Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
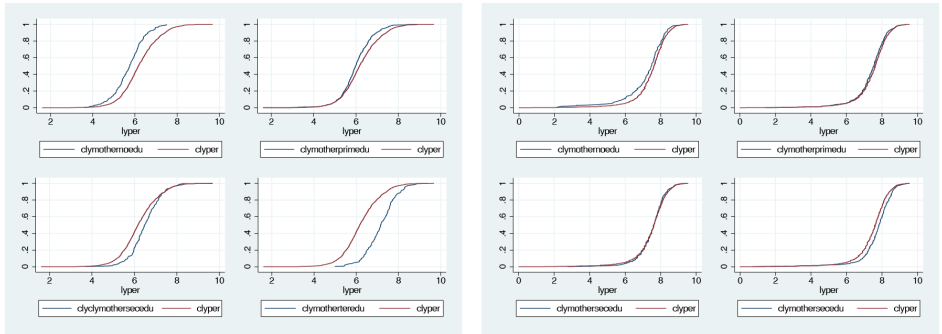
(A) 2003/2004

(B) 2013

FIGURE 4: Years of education conditional to ethnicity
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).

(A) 2003/2004

(B) 2013

FIGURE 5: Logarithmic Income - Conditional Cumulative Distribution Function to father education
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
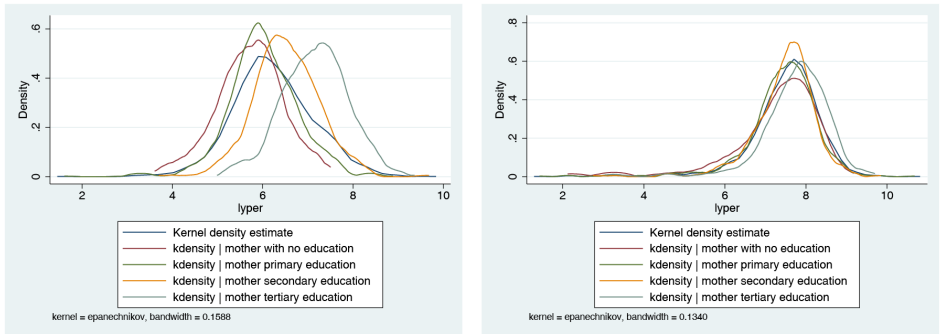

(A) 2003/2004

(B) 2013

FIGURE 6: Kernel density of logaritmic income conditional to father education
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed
with the algorithm Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
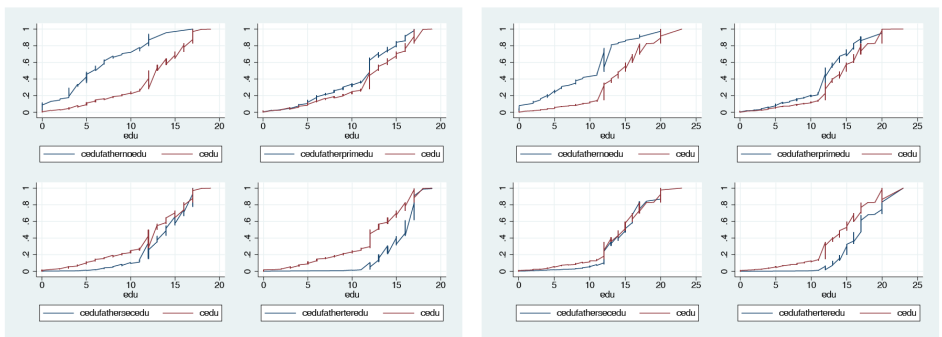
(A) 2003/2004

(B) 2013

FIGURE 7: Logarithmic Income - Conditional Cumulative Distribution Function to mother education
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).

(A) 2003/2004

(B) 2013

FIGURE 8: Kernel density of logaritmic income conditional to mother education
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
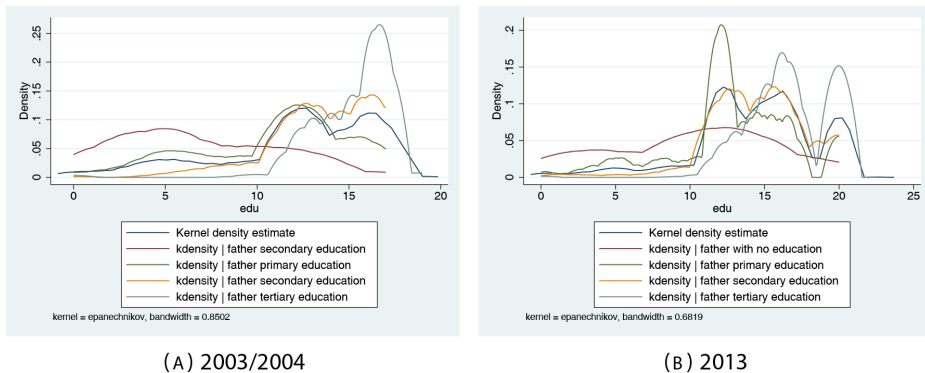

(A) 2003/2004

(B) 2013

FIGURE 9: Education - Conditional Cumulative Distribution Function to father education
Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).

(A) 2003/2004   (B) 2013

FIGURE 10: Kernel density of years of education conditional to father education

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estad´ısticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).
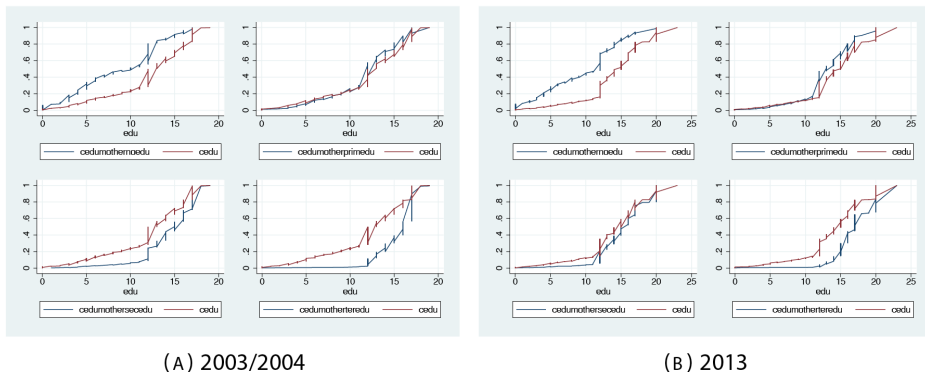

(A) 2003/2004   (B) 2013

FIGURE 11: Education - Conditional Cumulative Distribution Function to mother education

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
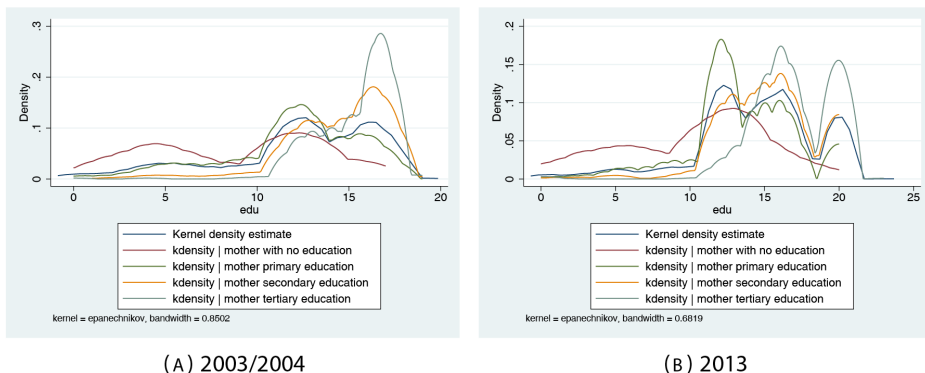Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).

(A) 2003/2004   (B) 2013

FIGURE 12: Kernel density of years of education conditional to father education

Source: Author's calculation based on: Continuous Household Survey 2003/2004, Household Survey 2013
(Instituto Nacional de Estadísticas - Bolivia). Outliers in income detected and removed with the algorithm
Blocked adaptive computationally efficient outlier Notminators - BACON (Billor et al., 2000).